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ABSTRACT

A new conceptual approach to the analysis of educational systems is defined. It centers attention on the instructional management decision making process, which serves to mediate the activities of the students and learning environment, so that much of the present confusion surrounding the design of educational systems is eliminated. Instructional management is defined as those events and procedures involved in the decision to initiate a specific activity for an individual student. Several forms of instructional management are identified, including: 1) aspiration management, 2) prescriptive management, 3) achievement management, 4) motivation management, 5) enrichment management, 6) maintenance management, and 7) support management. Appropriate strategies employed in each of these management forms are reviewed in this paper. Likewise, media as they relate to the implementation of various aspects of instructional management procedures are analyzed. Finally, the relationship of instructional management to individualized instruction and accountability is considered. (Author/JK)

THE MANAGEMENT OF INSTRUCTION

by

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ABSTRACT

This paper defines a new conceptual approach to the analysis of educational systems. The authors believe that by centering attention on the instructional management decision making process, which serves to mediate the activities of the students and learning environment, much of the present confusion surrounding the design of educational systems can be eliminated.

> Instructional management is defined as those events and procedures involved in the decision to initiate a specific activity for an individual student.

Several forms of instructional management are identified, including:

(1) Aspiration Management
(2) Prescriptive Management
(3) Achievement Management
(4) Motivation Management
(5) Enrichment Management
(6) Maintenance Management
(7) Support Management

Appropriate strategies employed in each of these management forms are reviewed in this paper. Likewise, media as they relate to the implementation of various aspects of instructional management procedures are analyzed. Finally, the relationship of instructional management to individualized instruction and accountability is considered.

INTRODUCTION

The last decade has seen the rapid rise of an increasingly sophisticated technology of instruction. What began as a movement to apply principles derived from the learning laboratories to the construction of programmed instruction materials has been combined with systems analysis techniques to lead to new empirical approaches to instruction and large scale efforts at individualization. The result has been a searching re-examination of nearly all instructional practices, including new approaches to instructional materials design, evaluation, educational responsibilities, and media selection. It also has resulted in a re-examination of the teacher's role in the classroom.

To date most innovations in education have been primarily concerned with improving the quality of the presentation. Films, educational television, audiovisual devices, even team teaching are examples of this trend; but, "good" teaching is not synonymous with good display. The quality of any educational activity depends on:

(1) the form and duration of presentation and display (stimuli).

(2) the nature and extent of student participation (responses)

(3) the accuracy of decisions regarding the assignment of the most appropriate learning activities for a student considering his needs, abilities, aspirations, and motivations (consequences).

If we examine the experimental literature we can find many "media studies" which investigate display factors. A few studies, mostly those dealing with programmed

instruction are concerned with factors involved in student participation; but almost no information is available analyzing factors relevant to the decision making process in the classroom. Lack of "good" research into instructional management procedures may in part be due to the fact that to date there has been no consistent definition of the kind of activity subsumed under this category. It is hoped that this paper will go a long way in mitigating that problem.

INSTRUCTIONAL MANAGEMENT ACTIVITIES

One of the most common examples of instructional management occurs when the teacher, after ascertaining that a student is having difficulty learning a particular skill, decides to assign special homework, or to provide individual tutoring.

Tosti and Ball, 1969,[1] elaborate on the general logic of this activity and define three functions that must be performed in instructional management. These are:

(1) assessment, in which some samples of student behaviors or environmental conditions are observed and summarized.

(2) decision, in which the data is evaluated in terms of some criteria set for various purposes resulting in the assistant of some specific presentation.

(3) initiation, whereby assigned actions are begun (or terminated).

Other researchers have considered alternative ways of describing this process. For example, Rhode, et. al., 1970,[2] used a variation of the Tosti-Ball presentation design model in classifying media used in Air Force training. They separated the management function into two somewhat independent activities of evaluation and prescription. They reasoned that because the activities associated with giving pre and post test are so easily defined in an instructional setting, evaluation should be

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1 Tosti, Donald T., and Ball, John R., "A Behavioral Approach to Instructional Design and Media Selection". AV Communication Review, Vol. 17, No. 7, Spring 1969.

2 Rhode, W., Esseff, P., Pusin, C., Quirk, F., and Shilik, R., Analysis and Approach to the Development of an Advanced Multi-Media Instructional System. Wright-Patterson AFP : AFHRL-TR-69-30, Vol. I, 1970.

given an independent status, Bloom, Hastings, and Madaus, 1971,[3] also separated the act of evaluation from the use of resultant data in diagnosis and decision making. However, the authors feel this separation is not necessary, and perhaps even misleading. As Tosti and Ball state: "It is difficult to justify evaluation as an end in itself, data should be collected for some purpose of decision."[4]

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3 Bloom, B.S., Hastings, J.T., and Madaus, G.F., Handbook on Formative and Summative Evaluation of Student Learning, McGraw-Hill, 1971

4 Tosti, Donald T., and Ball, John R., op. cit.

TYPES OF INSTRUCTIONAL MANAGEMENT

It is evident that the three elements of instructional management : repertorire, assessment, assignment decision, and initiation of new activity, can vary in their composition depending on the purpose of management.

Based on the activities integral to an instructional system, we have isolated seven forms of instructional management. These management forms may be conceptualized as lines[5] that connect the instructional systems activities. This model is illustrated in Figure 1.

INSERT FIGURE ONE PLEASE

The purpose of each of the seven forms of instructional management identified in Figure 1 may be briefly defined as follows:

(1) Aspiration Management

Purpose: To select those objectives that will best meet a given students aspirations, aptitudes, or interests.

(2) Prescriptive Management

Purpose: To ensure that a given student receives the materials appropriate to his individual characteristics to most efficiently meet his objectives.

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5 This makes what we are calling decisions rather synonymous to "activities" in a PERT flowplan. In PERT, however, the time that activities take are indicated by the length of the line while the "events" (represented by circles) are instantaneous. In our model, the lines representing decisions do no signify time, while the boxes representing activities do take time.

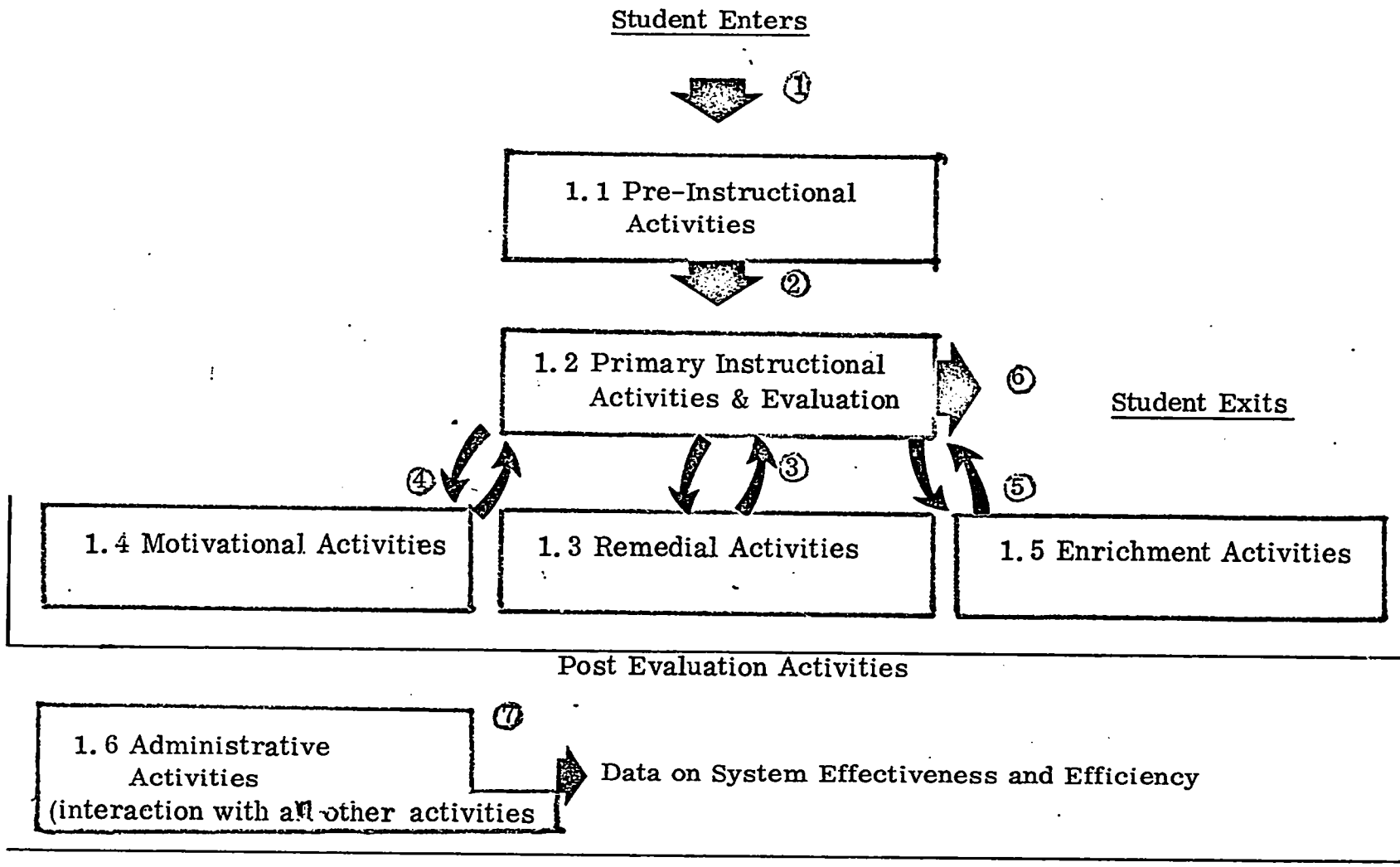

Figure One: Model of an Instructional System

FIGURE ONE

(3) Achievement Management

Purpose: To ensure that the student has mastered the objectives specified.

(4) Motivation Management

Purpose: To ensure continual student interaction with the educational environment in order to increase individual learning rates and performance levels.

(5) Enrichment Management

Purpose: To provide for access to additional information relevant to the objectives, but not necessary for their attainment.

(6) Maintenance Management

Purpose: To ensure student ability to perform on the objective is maintained at a prespecified criterion level.

(7) Support Management

Purpose: To assure that such data be collected as is necessary to keep the instructional system operating effectively and to provide individuals outside the system with information they require to evaluate and revise the existing instructional system.

Each of these types of instructional management has implications for both the instructional design specialists and the supervisors of existing systems.

The consideration of each of these types of instructional management and the degree to which they are formally dealt with varies greatly in existing programs. For example, few programs deal with motivation on a formal basis, but most systems provide for some kind of remediation and therefore produce some form of achievement management.

ACHIEVEMENT MANAGEMENT

We have chosen to discuss achievement management first because it is by far the most common form of instructional management. It may occur whenever a student "error" is detected and its purpose is to remediate such errors. The lecturer who suddenly realizes from student questions that his lecture has been "over their heads" has taken the first step in achievement management. If he now modifies his presentation to remediate those misunderstandings he has performed an achievement management act.

After a student has interacted with an instructional presentation, it is appropriate to determine if he has acquired the information that was contained in that presentation. This "check" on mastery and the subsequent decisions for remediation defines another form of achievement management.

When it is determined that a student has failed to learn a particular unit of material, there can be two causes: 1) either the student did not attend to the information properly, or 2) he did not have in his repertoire the appropriate prerequiste knowledge to allow him to process the new information. Depending upon the manager's evaluation of the student's failure, there are four strategies the manager can use to remedy the achievement failure. These are:

- Redundancy: The student may be asked to repeat the same or continue through many similar instructional presentations until the student attains the objectives.
- Multi-Form: The student may be asked to review the same information in a different instructional presentation form or via a different medium.

- Multilevel: The student may be asked to review the same information at a lower level of presentation (i.e., in a more expanded form using simpler vocabulary, syntax, etc.)

- Error-Diagnostic: The student is branched to an alternative presentation specifically designed to correct that particular error.

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Bloom, et. al., (1971), proposed the use of what they call formative evaluation procedures for making instructional decisions. In their analysis they ascribed two separate functions to formative evaluation. These are:

1) to act as feedback to students as to their progress, and,

2) to locate student errors for the initiation of remedial assignments.

In our analysis of achievement management, we contend that the first function may be considered a specific case of the second, i.e., the the primary effect of feedback is to act as a stimulus for the student to take some action of self-remediation. This does not mean we are ignoring possible reinforcing effects of feedback, but the data tend to indicate that motivational effects of feedback alone are most often transit, occurring only in the early stages of instruction.

The fact that achievement management procedures are often confounded by motivational effects, has resulted in considerable confusion in the analysis of such strategies. For example, often in achievement management systems, a "mastery contingency" is imposed, i.e., the student is required to master a set of objectives before he is allowed to attempt a new set. Frequently an error diagnostic strategy is then used so items he missed are keyed to remedial activities. Although this strategy

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6 Bloom, Hastings, Madaus, op.cit.

is obviously an important one in achievement management, the effects of the mastery contingency may be more important to motivation management.

It is ironic to note that while in most forms of programmed instruction much feedback is available to the students, no real contingencies exist. Yet the early proponents of such systems emphasized the motivational properties of the feedback. In contrast, in most individualized instructional programs, contingencies are provided by the mediation of another person (usually a teacher or teacher aid). Yet these programs tned to give far too little credit to the motivation properties of their strategies.

ASPIRATION MANAGEMENT

Aspiration Management is concerned with the selection of sets of objectives which will allow a student to achieve a desired goal. Such a goal may be long range, or may reflect very short lived interests. For example, the student who wants to be an engineer and therefore elects mathematics courses in high school is engaging in a form of aspiration self-management, so is the student who is suddenly interested in ecology, leads him to select a library book on the subject. In the latter case, the student is satisfying a more immediate goal.[7]

Many advocates of individualized instruction state that in their system the instructor and student frequently sit down and discuss what learning goals the student would like to pursue. In practice however, such systems rarely allow student preferences to be used to make such decisions. In fact, most individualized systems place such heavy emphasis on achievement that they so limit the options available to the student that aspiration management becomes virtually impossible. Usually aspiration management is only practical in either highly developed systems in which a sufficient "inventory" of instructional modules are available, or in very unstructured stituations such as free schools where little or no formal achievement manag ement is practiced.

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7 Self selected interest are not the only data that may be formally considered. Aptitude and vocational interest test may also be used in selecting appropriate objectives for a student.

Many researchers feel that some form of aspiration management is a necessary condition for individualized instruction. Mager, for example, states that: "An instructional system is individualized when the characteristics of each student play a major role in the selection of objectives.."[8] The authors believe, however, that it is erroneous to conclude that because any one form of instructional management is absent from a given system, that the system is not individualized. Nevertheless, we have noted that some of our colleagues emphatically deny that a given instructional system is "truly" individualized if it omits a particular form of instructional management; it seems that each management form has its patrons.

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8 Mager, Robert F., "Advantages of Individualized Instruction", paper delivered at the National Society of Programmed Instruction, 1968.

PRESCRIPTIVE MANAGEMENT

It may be considered a waste of resources and an imposition on the student to force all students through the same learning experiences. There are many individual differences among students and the more such differences are used to prescribe instruction the greater the efficiency of the system.

The most frequently used form of prescriptive management involves the use of data from achievement pre-tests to determine proper curriculum placement. This form of prescription allows the teacher to assign certain instructional units, exercises, or supplementary activities to the learner based on his pre-test scores, teacher's knowledge of the materials, and the knowledge of the learner's past performance.

Prescriptive management strategies for curriculum placement vary in their complexities. The most elementary form can be seen in the "skip ahead, if you know this material" options given in many programmed instruction courses.

A far more complex extension of this management form is found in prescriptive methods which measure large knowledge areas. Thus, a learner who is weak in a specific arithmetic skill, such as division of fractions, may not have to learn addition of fractions (unless he tests poorly in this area too). The resulting assignment should include instruction in only those skills which he requires.

The outcome of a prescriptive pre-test may lead directly to a curriculum decision or may indicate the need for more precise testing. Flow charts may be employed

as devices to aid the instructor to make accurate prescriptions. Figure Two shows a Prescriptive Flow Chart used by Job Corps teachers in their mathematics program:

PLEASE INSERT FIGURE TWO

As can be seen, some outcomes tell the teacher to assign a particular instructional unit, while other results indicate the need for further testing.

A form of prescriptive management frequently proposed, but seldom delivered is that which is designed to accomodate various "learning styles". Proponents of such systems often make statements like:

> There are differences in learning styles, for example, some students learn better from pictorial presenations and others learn better from text. So, let us select the best instructional path for students considering such differences.

The general strategy for such forms of prescriptive management involve analyzing a given students behavioral profile prior to instruction in order to predict what the most appropriate instructional path for him would be. This "ideal path" would be designed to allow him to achieve the objective in the most efficient manner possible.

In practice, however, what is usually done is to substitute an achievement management strategy in place of this type of prescriptive management. Students are forced through a given learning experience and then if they fail to meet the objectives one of the standard strategies of achievement management is used to remediate their difficulties. To obscure the fact that what is delivered is not what was promised, the

Prescriptive Test Results (Tests Form PO1)

Pre-test A	Pass	Pass	Pass	Fail	Fail	Fail	Fail	Pass
Pre-test B	Pass	Pass	Fail	Fail	Pass	Pass	Fail	Fail
Pre-test C	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail
	↓	↓	↓	↓	↓	↓	↓	↓
	Take test PO7	Enter math M5	Enter math MO	Take test P11	Enter math M5	Take test PO4	Enter math M2	Enter math M1

FIGURE TWO

assignment given is often called the "prescription".

Two quite different strategies of prescriptive management for accommodating learning styles have been proposed.

The first of these may be called the iterative method. This strategy requires that a "historical profile" of student success be documented on specific instructional modules. Then the profiles of subsequent students are statistically matched to the historical profiles to predict the success of these new students on these specific modules. The new student is then given the "best" module for him selected from the inventor of parallel modules available.

The second strategy may be called the a priori method; in this strategy individual characteristics of each student are used to predict that students success on all instructional activities which use a particular presentation form or medium. For example, a poor reader may be given an audio-cassette version of the module.

The iterative strategy has so far proven to be a more practical approach. The historic profile for a given module of instruction is established from data on success-failure rate of students who have completed this model via a multiple regression technique. This then allows one to define a student for whom this particular instructional

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9 It has been argued that even if prescriptive management to accommodate "learner style" were practical, it's execution would actually be a disservice to students. Since much learning and reference material that exists outside the system uses display forms that may not be encountered, the resulting inability of the student to handle such material would be contrary to the proposition that one of the primary purposes of education is to teach the student how to learn.

module is ideal. Obviously, the strategy does not require any analytical description of the characteristics of the module since it is specific to the particular content, presentation form, and medium of that module.

In order for either strategy to be efficient, parallel instructional modules must be developed. These parallel modules must significantly "fit" various student profiles while reaching the same objectives. The resulting investment necessary to prepare alternative instructional paths must be justified in terms of possible increase in total system efficiency and effectiveness afforded by their use.

MOTIVATION MANAGEMENT

No matter how good the learning system is, if we can't keep the student in the learning environment and responding at a satisfactory pace, the system will fail. One solution is to build motivational activities into instructional systems that ensure that the student's learning activities lead to some positive consequence. Such a concept is in perfect agreement with laboratory studies on reinforcement which typically use the positive consequence of eating or drinking to motivate behavior. Although equivalent kinds of reinforcement have been used with students, such payoffs are usually impractical in classroom use. Students cannot be starved, nor can candy be placed in their mouths for correct responses. There are, however, many other kinds of preferred activities that can be employed in the classroom.

One formal administrative technique employed to provide positive consequences for activities has been termed "contingency management."[10] Contingency management is defined as "that procedure which provides some positive consequential activity to be contingent on the satisfactory execution of some desired behavior." In some programs students "contract" for rewards. For example, a student contract may state: "If you do your assignment and get 100% on the Progress Check Test, you may go out and play."[11]

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10 Homme, L.E., and Tosti, D.T., "Contingency Management and Motivation." NSPI Journal, 1965, 4, 14 - 16

11 Tosti, D.T., and Loehr, John, "Antecedents of Contingency Management." Educational Technology, April, 1971, Volume XI, Number 4, 11 - 14

Student contracts for reinforcing activity have been used in settings varying from preschool to college.

The management for motivation follows precisely the same formal procedures as does any other form of instructional management; that is:

- appraisal of some attribute of the student's behavior,
- decision to select or assign some preferred activity (or token), and
- initiation of the student's exposure to, or engagement in that activity.

While there is nothing inherent in the techniques described that would indicate that some form of contingency management is not practical within a conventional group instructional situation, it is clear that these requirements might be more easily and frequently achieved in an environment for which procedures appropriate to a greater degree of individualized instruction already exist.

A variation of the contingency management approach is the establishment of a token or micro-economy.[12] In such systems, satisfactory performance leads to the deliverance of "points" or tokens which can later be used to "buy" desirable objects or activities. A technique often used both at the secondary and the college level is to give grades on the basis of a cummulative number of points earned by taking tests and or working on a project. Such systems are obviously special cases of a micro-economy strategy.

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12 Ayllon, T., and Nathan, A., The Token Economy, Appleton-Century Croft, New York, 1968.

As was pointed out earlier, many individualized systems that employ some form of achievement management impose a "mastery contingency", e.g., the student must achieve 90% of the objectives of a section before he is allowed to progress on to the next segment. A number of researchers have pointed out that this clearly establishes a strong motivational contingency.[13] It is interesting to speculate that while most proponents of individualized instruction emphasize the prescriptive and remedial decisions made in their programs, it is quite possible that the motivational management component introduced by the mastery contingency is the most important factor in the success of such programs.

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13 Keller, Fred S., Neglected Rewards in the Educational Process, paper read at the 23rd. annual meeting of the American Conference of Academic Deans at Los Angeles, California, January 16, 1967.

Tosti, Donald T., and Homme, L.E., op. cit.

ENRICHMENT MANAGEMENT

Enrichment involves the selection of materials that are related to the basic core content, but which go into more depth or present interesting sidelights into core concepts. Some reasons given for enrichment management are that it acts as a time filler, it aids to motivate the student, it provides for greater generalization and so on. This type of management will undoubtedly become more important as systems become more refined. At the moment it usually exists not by plan, but because system objectives are so vague that instructions are uncertain whether a particular module is necessary to the achievement of a particular set of objectives or not.

MAINTENANCE MANAGEMENT

To few existing instructional system takes upon itself the task of assuring that the student be able to recall important information or continue to maintain a skill after he has left the formal learning environment. In many programs in fact, its a subject for embarassed laughter that students forget the subject-matter of a course the day after they take the final examination.

Ensuring "retention" is often accomplished by some curriculum decision rather than as an instructional management act. If, for example a specific amount of retention is desired (e.g. the multiplication and division facts). A great deal of practice which yields over learning may be given. Often instructional materials are developed in a spiral curriculum which "reconditions" previous learning just prior to the introduction of new information. Both of these techniques are an example of insuring "retention" by curriculum design rather than by instructional management.

A new system called Comprehensive Achievement Monitoring (CAM) has been developed by W. P. Gorth and P. Schriever, University of Massachusetts and Robert O'Reilly, New York State Education Department. It is a combination of prescriptive, achievement, and maintenance management. In this system, a one year's work in a subject area such as elementary arithmetic is specified in terms of a series of objectives. Parallel test batteries are then prepared to measure student performance on these objectives. Students are given a complete battery at regular intervals throughout the

the year. Test results are assessed by a computer. The reduced data on individual student achievement are then given to the teacher. The possible decisions available to the teachers are to accelerate the student in the curriculum (prescriptive management) or schedule remediation (achievement management). The CAM may also reveal a performance loss over time which would require the student to engage in additional review (maintenance management).

Maintenance management often implys that some counseling/decision making functions be provided for the student who is preparing to leave the instructional system. The student should be advised as to future courses he should take to maintain his present skill level. Or, it may be that he should learn particular exercises to be performed at a certain frequency if his skills are to remain sharp.

The instructional system that does not concern itself with maintenance of the student's repertoire is perhaps admitting that its subject matter is simply knowledge to be acquired and then promptly forgotten.

The instructional system that <u>does</u> concern itself with maintenance receives the added benefit of being forced to ask itself just how long and to what end its students are being asked to acquire knowledge.

SUPPORT MANAGEMENT

Some data naturally arises from any system (e.g., student time, number of instructors, or aids required to keep the system running, mean final exam scores, etc.) and other data can be collected with a certain amount of effort.

Some of these data may be used to make decisions in the operational system to provide logistic support relevant to materials availability, scheduling, administrative grading, and maintenance of the operating facilities.

Other data may serve as inputs to a separate Curriculum Development and Revision System. Obviously there must be some reasonable trade-off between how much classroom manager effort should be alloted to gathering data that is irrelevant to present students and the need to have such data to help change curricula in such a way as to help future students. There is no easy answer to this problem; however, as we indicated in our later disucssion of accountability (clearly a tool that very much depends upon support management data), the computer may soon make the gathering of such data a simple task that the classroom manager need not concern himself with it at all.

AN OVERVIEW OF INSTRUCTIONAL MANAGEMENT

We have summarized some of the strategy that may be employed in, or to illustrate some possible relationships between instructional management decisions and student activities. It must be remembered, however, that there is considerable variation in data source, strategy, and media that may be employed so that the examples given here are only representative of a wide range of possibilities.

INSERT FIGURE THREE

INSTRUCTIONAL MANAGEMENT AND INDIVIDUAL INSTRUCTION

Utilizing our concept of instructional management, a clean distinction between individualized and non-individualized instruction can be made. The distinction between individualized and non-individualized instruction is not made on the basis of whether or not 100 students are experiencing the same learning activity at the same time, since it is possible that every one of them should be engaged in this activity at this time. Nor should the distinction be made on the basis of whether the instructional system allows a student to progress at his won pace or not. A book can do this. Instead, the degree of individualization must be defined in terms of instructional management. This means that:

> Individualized instruction is a function of the frequency with which the decision to change the instructional presentation is made as a result of the assessment of an individual student's achievement, needs, or goals.

INSTRUCTIONAL MANAGEMENT DECISIONS	STUDENT ACTIVITIES
Aspiration Management - Instructor and student determine which objectives, units, or courses are appropriate to the student's general goals or needs.	Student takes appropriate pre-tests, diagnostic quizzes, etc.
Prescriptive Management - Based on diagnostic data, the instructor and student determine where he should begin to study, what units he should study, and perhaps what media should be employed.	Students work through selected instructional materials.
Achievement Management : Students take a post-test to determine if he has mastered the instructional unit.	If the student has failed to master the unit, he goes to remedial materials, otherwise he proceeds to the next appropriate unit. He may interspace motivational or enrichment activities first however.
Motivation Management : Instructor and student negotiate what amount of reinforcement the student should get for what amount of achievement in the instructional materials.	Student takes part in some reinforcing activity for a specified period of time. Usually he then returns to the instructional materials activity.
Enrichment Management : Instructor and student determine when "extra" materials should be added to the student's program of study.	Student works through selected enrichment materials (projects, etc.).
Maintenance Management : When the student has completed an instructional activity, he and instructor consider what he can do in the future to maintain his newly acquired skill.	Student Leaves System, later perhaps student takes part in activities to boost or maintain his newly acquired skills.
Support Management : Instructor determines which data to gather to make decisions about system's efficiency and effectiveness.	(Teacher Activity) Instructor gathers files and tabulates data in the form of tests, times, units taken, etc.

FIGURE THREE

The presence of large groups in an instructional setting tends to inhibit the individualization process due to the logistics of data collection, processing, assigning, and so forth. Still, limited individualized instruction occurs in almost every classroom. When an instructor stops to modify his presentation as a function of a student's query, that student (but not the twenty-nine others who are in the room) is receiving a form of individualized instruction.

The authors are confident that as instructional systems' designers become more aware and concerned with management and decision making aspects of instructional environments, they will automatically increase the individualization available in those environments.

MEDIA EMPLOYED IN INSTRUCTIONAL MANAGEMENT

For purposes of classification, we may define an educational medium as any device capable of processing, storing and transmitting information within the instructional system. This allows the development of a classification scheme which parallels the Tosti and Ball presentation dimensions.[14] The three major media types include:

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14. Tosti, Donald T., and Ball, John R., 1969, op. cit.

- Display Media - those which present information to and attended to by the student to teacher (books, film, CRT's etc.).
- Response Acceptance Media - all media which accept student responses, (keyboards, optical scanning equipment, note pads, blackboards, blue books, or even teachers).
- Instructional Management Media - those involved in deciding what activities the student should engage in. These devices may be further classified into three sub-groups.

    1. assessment media, devices which grade and/or reduce data concerning student response
    2. decision media, which compare the processed data to a set of criteria to make decisions regarding future student assignments
    3. initiation media, which activate the assigned activities.

We shall concentrate here only with the media employed in instructional management. Just as there are media designed for display, and media for response acceptance, there are educational media which have instructional management as their primary function. Such management media include teachers, computers, teacher's aides, peer monitors, various types of paper diagnostic forms, and the individual students themselves. Some aspects of these media are briefly considered hereafter.

- Instructor Management

The instructor is obviously a flexible and potent management medium but giving individual assignments to each of thirty students within present classroom constrains usually isn't practical. This difficulty can be mitigated by the introduction of some of the new display media which free the instructor from the normal role as a dispenser of information, to give him more time to manage the educational environment. There are also trends toward differentiated staffing which would allow teacher aides or para-professionals to perform some of the supporting activities.

- Computer Management

Computers may be totally or partially substituted for the instructor within the management function.[15] In the limited case, the computer would only perform the function of assessment (grading and reducing the data). The instructor would then still make the assignment decisions and initiate the activities. The senior author has already advanced a strong argument for Computer Managed Instruction in terms of its positive effects on teacher behavior. In his evaluation of Project PLAN Classroom he found that in those where teachers prevented students from interacting directly with the CMI System, performance was inferior. He concluded that, "the requirements to having to 'feed' the computer and respond differentially to its output caused the teacher to adopt a series of instructional management behaviors which facilitated learning. One of the most important by-products of computer managed systems may be to keep the teacher 'on the track'."[16]

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15 As an especially good example of this, see SCD's Working Paper : SDC Counseling Service/Toward 2000.

16 Tosti, D. T., Principal Investigator, "An Observation and Analysis of Instructional Management in Project PLAN Classrooms." Westinghouse Learning Corporation, 1968.

Proctor Management

Although the computer has stirred the greatest interest, it obviously is not the only non-instructor management medium that can be used. By far the most widely used of these media are the teacher aides or proctors. The proctors are usually more advanced students or sometimes peers. In such systems, the aides are used primarily as assessors, but are sometimes involved in the decision function and less frequently as initiators.

Dr. Fred Keller, a leading exponent of proctor-managed instruction has listed five features which distinguish his system.[17] These are:

(1) at the go-at-your own pace feature which permits a student to move through the course at a speed commensurated with his ability and other demands upon his time;

(2) the unit-perfection requirement for advance, which lets the student go ahead to new material only after demonstrating mastery of that which preceded;

(3) the use of lectures and demonstrations as vehicles of motivation, rather than sources of critical information;

(4) the related stress upon the written word in teacher-student communication; and finally,

(5) the use of proctors, which permits repeated testing, immediate scoring, almost unavoidable tutoring, and a marked enhancement of the personal-social aspect of the educational process.

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[17] Keller, Fred S., "Neglected Rewards in the Educational Process." Read at the 23rd Annual Meeting of the American Conference of Academic Deans at Los Angeles, California, 1967.

Obviously most of these features are not unique to Dr. Keller's system. Those teachers who use the system emphasize the "personal aspects" of the student-proctor interaction. There is no data, however, to support the contention that a "less personal" management medium would produce any significant changes in either student learning or motivation.

- Student Management

We must remember that at the student-computer, or student-tutor interface, there are at least two devices capable of evaluating data and making decisions. We often overlook the fact that the student himself can assess much of the data and make his own decisions. These decisions may require only minimal guidance from the computer (or from a teacher). For example, the student views the presentation, makes his response, and the computer assesses it; we now have at least two options. The computer can make the decision to branch to an appropriate learning sequence to remediate any deficiences, or it can provide the student with the assessed data and allow him to initiate his own achievement management (error correction) behavior.

It has been estimated by Koontz, who conducted a CAI project at the Naval Academy, that perhaps 80% of all student errors could be remediated by merely having the student re-examine the original presentation.[18] This, of course, requires that an analysis of error class be made to distinguish between those errors that occur because of "carelessness" and those that result from a repertoire deficiency.

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18 Koontz, J., Personal Communication, 1971.

Simple providing the student with disconfirmation, i.e., informing him of his error and allowing him to take self-managed achievement activities, may not only mitigate many logistic and cost problems, but strengthening the "act of self-remediation" may in itself be a desirable behavioral outcome. In many situations developing the behavior or "independent" learning should be encouraged. In recent experiments with Junior College students in an individualized program, self-management was found to be the most significant factor in student success.[19]

- Management Media Mix

Each of these instructional management medias, the teacher, the computer, the para-professional aide, the peer group member, or the student himself have some advantages and some limitations. The instructional system designer's problem is to develop a total system that will incorporate the best mix management media. The development of such a mix is based on a general technology of instructional management as expanded and modified by continued research into strategies.

INSTRUCTIONAL MANAGEMENT AND ACCOUNTABILITY

Since accountability is currently receiving a great deal of attention in the literature (not to mention the popular press), it is perhaps worthwhile to conclude our discussion of instructional management by considering its accountability problems.

As a general rule, when we speak of accountability, we are speaking of achieving some particular minimal level of cost-effectiveness. That is to say, we expect that for a

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19 Beck, M.H., and Csanyi, A., "Junior College Demonstration Project". Final Report Behavior Systems Division, Westinghouse Learning Corporation, 1968.

certain expenditure of time and effort (usually measured as years of gain on standardized tests of reading, math, etc.).[20] This concept of accountability (or cost-effectiveness) is illustrated in Figure 4.

PLEASE INSERT FIGURE FOUR

This concept of accountability is appropriate for most current implementation efforts, especially as the efforts are largely being undertaken by outside contractors. When the time comes that school systems undertake their own accountability efforts and when it becomes necessary to analyze the general cost-effectiveness data in detail in an effort to make specific changes in the system, then a more precise series of accountability measures are necessary. The temptation, in any cost-cutting situation is to abandon a systems approach and to try to cut building costs, or labor costs, or to attempt to some other non-mission orientated strategy.

The instructional management system has the advantage of allowing an administrator to monitor costs in the context of a mission oriented systems approach. Students participate in activities. Students, classroom managers, or other instructional management media make decisions between activities that determine which portions of the succeeding activity the student will engage in. This network can be mapped and the frequencies of various paths through the system determined. In this manner, cost-

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[20] Harmon, Paul, "Curriculum Cost-Effectiveness".

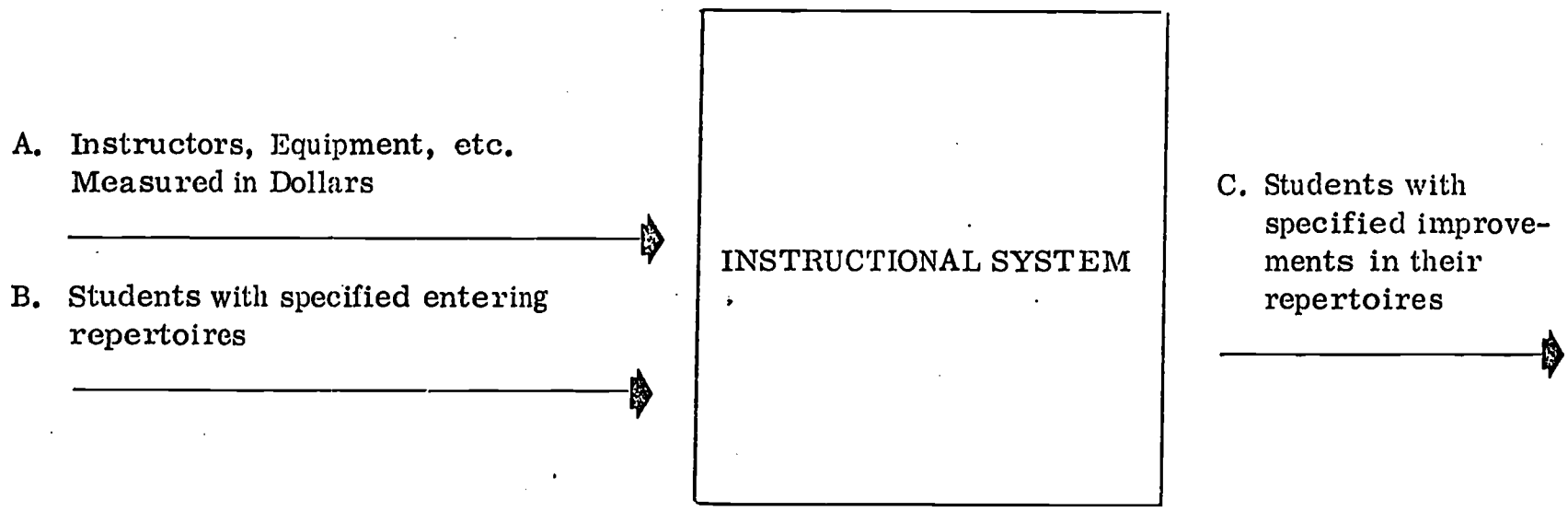

FIGURE FOUR

ACCOUNTABILITY MODEL

$$\text{Cost-Effectiveness} = \frac{C-B}{A}$$

effective paths with their concomitant equipment and decision times can be located. This allows for rationale system pruning.

This sort of cost-effectiveness analysis is possible only when decision paths are clearly isolated and tracked, as is possible with the instructional management model.

Naturally the more complex the web, the more individualization is possible. But, if data indicates that some paths are not used or little used, then it is reasonable to prune those paths to reduce costs. Obviously the more paths that are pruned, the less the system is individualized. The ideal balance between individualization and low costs should be a web that is very cost-effective.

If certain paths consistantly fail to produce results (behavior change as measured by post-test), then obviously each component (both activities and decisions) of that path should be examined. An instructional unit may be defective, a test may be making faulty predictions, the component, once isolated, should be corrected to the degree practicable.

Obviously a computer can be utilized rather effectively in sophisticated systems to help the classroom managers monitor the loads and effectiveness of various paths through the instructional network. In some cases the decision making can be formalized as a result of system operating data so that students, peers, or machines, can make the decisions, thereby freeing classroom manager time and in the long run reducing the total amount of classroom managers required to operate the system.

SUMMARY

This paper has described a new conceptual model of instructional management that has found usefulness in the analysis and design of the instructional components in educational systems of various complexities.

In the opinion of the authors, it is likely that a revolution in the quality of education will not come from the availability of new media, the introduction of any specific devices like the computer or teaching machine, the introduction of improved evaluation methods, the specification of behavior objectives, or the development of effective motivational sub-systems, although all of these will, in their way, contribute. Instead, a radical change in the quality of American education will come from the increased application of the growing body of knowledge about the form, purpose, and processes involved in classroom decision making.

The authors have found the model is useful in understanding what is happening in today's classrooms, and are confident that it will prove even more useful in the near future. The authors believe that more and more new media will become available, and that independent instructional materials will release teachers from the role of classroom lecturer, (i.e., principal source of information). The new teacher will need to become a skilled and sensitive observer of the student's learning behavior, and who is prepared to assist the student when he reaches a decision point. The role of the teacher will be that of a manager of the total instructional environment.